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Review Paper

In-Vivo Anti-Inflammatory Activity of The Novel Combination of Vigna Radiata L. And Finger Millet E. Against Osteoarthritis: A Review

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ABSTRACT

Cartilage deterioration, inflammation, and a gradual loss of joint function are the hallmarks of osteoarthritis (OA), a degenerative joint disease that is chronic. Current pharmacological treatments, such as acetaminophen, non-steroidal anti-inflammatory medications, and intra-articular injections, mainly relieve symptoms without altering the course of the disease, despite its significant incidence worldwide. The need for innovative treatment approaches is highlighted by the complex pathophysiology of OA, which includes dysregulation of cytokines, proteolytic enzymes, reactive oxygen species, and inflammatory mediators. Natural goods have drawn interest because of their bioactive ingredients and few side effects, especially plant-based functional diets. The antioxidant and anti-inflammatory qualities of *Vigna radiata* (mung bean) and *Eleusine coracana* (finger millet) are attributed to their abundance of proteins, polyphenols, flavonoids, dietary fiber, and vital minerals. Through the modulation of oxidative stress and inflammatory pathways, experimental studies show that these plants have antioxidant, anti-inflammatory, and anti-arthritis properties. A dependable and repeatable method for assessing such treatment effects is the osteoarthritis model in Sprague Dawley rats produced by monoiodoacetate (MIA). This study highlights the potential of combining finger millet and mung beans as a unique, nutraceutical-based strategy for treating osteoarthritis (OA), addressing both underlying disease processes and symptom relief.

INTRODUCTION

Millions of individuals worldwide suffer with osteoarthritis (OA), a debilitating & complicated condition. As of right now, there is no disease-

modifying treatment for OA, & the medications that are available to treat its symptoms are mostly useless. Finding & developing novel medications is made much more difficult by the disease's

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complex nature & the absence of a proven animal model.

Prostaglandins, cartilage matrix fragments, neuropeptides, reactive oxygen intermediates, proteolytic enzymes, protease inhibitors, cytokines, growth factors & other pathophysiological processes are all dysregulated in OA, a disease affecting the entire joint.

When these variables are dysregulated, a cycle of cartilage, ligament & synovial degradation beings, which is followed by an inflammatory response & sensitization of the peripheral & central nervous systems. Acetaminophen, non-steroidal anti-inflammatory drugs, cyclooxygenase 2 (COX 2) inhibitors & intra-articular steroid or hyaluronic acid injections are among the current treatments for osteoarthritis.

Nevertheless, none of these medications have shown evidence of disease-modifying effectiveness. These medications are only marginally effective & after long-term use, patients frequently experience gastrointestinal side effects in addition to a significant pain burden. Inhibitors of matrix metalloproteinases, interleukin- 1 – convertase (ICE), cathepsin K, & the nutraceutical glucosamine are among the disease-modifying medications presently undergoing different phases of clinical research.

Novel NSAIDS, nitric oxide analgesics, and inhibitors against lipoxygenase and COX-2 are being explored in the clinic to treat OA symptoms. A lot of work is currently being done to find and validated OA biomarkers and disease models since the illness's complex pathology necessitates a systems biology approach to analyzing the molecular pathways of disease onset and progression.^[1]

Joint discomfort is the most typical sign of osteoarthritis. The gelling phenomenon refers to the tendency for the pain to get worse with movement, particularly after a time of rest. In contrast to rheumatoid arthritis, which produces stiffness for at least 45 minutes, osteoarthritis often lasts less than 30 minutes.

Patients may complain of unstable or locked joints. Due to discomfort and stiffness, these symptoms cause patients to lose function and limit their everyday activities. Although practically any joint can be impacted, the hands, knees, hips, and spine are the most frequently affected. Asymmetrical osteoarthritis is common. One knee may have severe, incapacitating osteoarthritis, while the other leg function nearly normally.^[2]

Osteoarthritis was once thought to be an articular cartilage disease, but more recent studies have shown that the entire joint is affected. It has been believed that the primary change is the loss of articular cartilage, but a number of secondary changes, such as subchondral bone remodelling, osteophyte formation, bone marrow lesions, changes in the synovium, joint capsule, ligaments, and periarticular muscles and meniscal tears and extrusion, are caused by a combination of cellular changes and biomedical stresses.^[3]

We looked at the relationship between surrogates for both mechanisms and OA of the hands, knees, or both in order to better understand the relative contributions of mechanical stress and systemic processes to OA of weight-bearing and non-weight-bearing joints. We postulated that whereas surrogates for systemic processes are more likely to be associated with the presence of hand OA, whether or not it co-occurs with knee OA, surrogates for mechanical stress are more likely to be associated with knee OA.^[4]

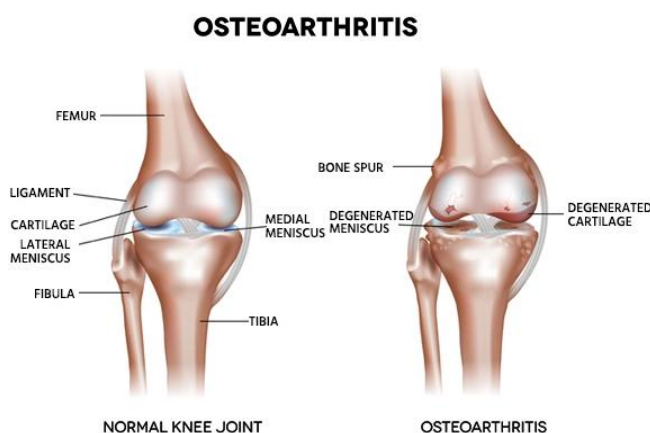


Figure No.1 Osteoarthritis Condition

Classification of Osteoarthritis: -

Based on the etiology of the disease, OA has traditionally been divided into primary (idiopathic) and secondary OA.

Primary Osteoarthritis: -

Degenerative changes in the joint cause primary osteoarthritis, a naturally occurring condition. Localized and generalized OA are two further classifications.

Secondary Osteoarthritis: -

While generalized OA affects three or more joints, localized OA only affects one. The causes and risk factor that contribute to OA in the joint are typically linked to secondary OA. Trauma, hereditary illnesses and other conditions affecting the bones or metabolism are among them.^[5]

The purpose of this study was to evaluate the biological, antiproliferative, and alcohol dehydrogenase (ADH) characteristics of several extracts from mung bean seeds and sprouts. All extracts from the sprouts had larger levels of total phenolics (TP), total flavonoids (TF), and 1,1-diphenyl-2-picrylhydrazyl (DPPH) radical scavenging activity than those from the seeds. Tyrosinase inhibition and DPPH levels were highest in the ethyl acetate (EtOAc) extract.^[6]

The incidence of metabolic syndromes, such as inflammation, dyslipidemia, and hyperglycemia,

has been associated with calorie-dense diets that are high in fat and carbs but low in protein, according to a growing body of clinical data. A variety of plant-based functional meals have been promoted by numerous worldwide health organizations, which has prompted calls for substantial dietary pattern changes to enhance health and prevent chronic diseases. Legumes (Fabaceae/Leguminosae) are considered the second most important crop for human consumption, behind cereals (Gramineae). However, because they are better sources of proteins, bioactive compounds, minerals, and vitamins than cereals, legume seeds—also referred to as "the poor man's meat"—are an essential part of the human diet.^[7]

Since millets were domesticated thousands of years ago at the beginning of human civilization, they are considered to be among the first grains. Millets, which are currently the sixth most important cereal in the world, provide a variety of nutrients as well as the health benefits of multigrain and gluten-free cereal products. Finger millet (*Eleusine coracana* L.), one of the most important millet family members, is widely farmed in Asia and Africa and is a staple food for many people in developing countries.^[8]

Finger millet is rich in nutrients and can be processed to increase its nutritional value.

Minerals, dietary fiber, essential amino acids, and carbohydrates are all present in sufficient amounts in finger millet. The calcium concentration of whole finger millet seeds is 0.34 percent, while that of other primary grains ranges from 0.01 to 0.06 percent. Among the health advantages of the grains are their hypoglycemic and hypocholesterolemic properties, as well as their well-known anti-ulcerative properties.^[9] The ability of an antioxidant to sequester free radicals is its main characteristic. Highly reactive oxygen species and free radicals come from a variety of sources in biological systems. In addition to causing damage to DNA, proteins, lipids, and nucleic acids, these free radicals can initiate degenerative diseases. Antioxidant substances that scavenge free radicals like peroxide and hydro peroxide include phenolic acids, polyphenols, and flavonoids. This prevents the oxidative processes that lead to degenerative diseases. According to scientific studies, antioxidants may reduce the incidence of long-term conditions like cancer and heart disease. *Eleusine coracana* L., also referred to as finger millet, is a very nutrient-dense millet with a lot of potential as a food source. It is the most frequently grown among India's little millets, and it needs to get more recognition by identifying its other nutritional benefits, such as antioxidant capability.^[10]

In addition to its nutritional value, millet is recognized for its several potential health advantages, such as enhancing wound healing, avoiding cardiovascular disease, and decreasing blood glucose and cholesterol levels. A previous study found that oxidative stress may be the underlying cause of several chronic conditions, including diabetes, cancer, neurological disorders, arthritis, and cardiovascular disease. Antioxidants are thought to play a major part in reducing oxidative damage.^[11]

Numerous animal models of OA are known, each with unique features. Anterior cruciate ligament

transection is one surgical technique that can be used. Destabilization of the medial meniscus (DMM) is employed in mice, but they are mainly carried out in rats and require expert surgical intervention. OA develops spontaneously in guinea pigs, and C57 black mice have been shown to experience spontaneous joint degeneration between the ages of 3 and 16 months. Although spontaneous OA models don't require any intervention to cause the illness, they are more common and therefore more expensive.

In contrast, chemically induced models are easier to use and allow for the investigation of OA lesions at various stages because they require far fewer intrusive procedures than surgical models. Single injections of inflammatory agents, immunotoxins, collagenase, papain, or monoiodoacetate—which can be hazardous if they leak out of the joint space—in the knee are examples of these models. MIA is the most widely used chemical model of OA, especially for evaluating the effectiveness of pharmaceuticals to treat pain since it produces a consistent, reliable, and quick pain-like phenotype that can be graded by varying MIA dosage.^[12]

The most crippling symptom for people with osteoarthritis (OA) of the knee is pain. Relatively few pharmacological studies have been carried out in the chronic phase of the monoiodoacetate (MIA)-induced rodent model of knee joint pain, despite suggestions that it may be better than other chronic or acute OA models for evaluating the analgesic efficacy of novel molecules. Therefore, the purpose of this investigation was to describe the chronic phase of the MIA-induced rat model of knee joint OA pain using pharmacological techniques.

Rats were given a single intraarticular injection of either vehicle (saline) or MIA at a dose of 2.5 mg into the left (ipsilateral) knee joint. Rats were given a single intraarticular injection of either vehicle (saline) or MIA at a dose of 2.5 mg into the left (ipsilateral) knee joint. Paw withdrawal

thresholds (PWTs) in the hindpaws were measured prior to MIA injection and twice a week until the study's conclusion on day 42 in order to gauge pain behavior. On day 7, mechanical allodynia totally developed in the ipsilateral hindpaws (PWTs ≤ 6 g) and continued until day 42. In accordance with a "washout" protocol, MIA-injected rats with PWTs ≤ 6 g in the ipsilateral hindpaws were given single doses of one of four clinically available medications that represent four different pharmacological classes: morphine, amitriptyline, gabapentin, and meloxicam. The intervals between subsequent doses were at least 48 hours. Both morphine and gabapentin produced dose-dependent anti-allodynia, although meloxicam and amitriptyline had no effect. Our results are consistent with clinical evidence that morphine and gabapentin reduced knee OA pain. The loss of descending diffuse noxious inhibitory controls in this model observed by others is consistent with amitriptyline's ineffectiveness.^[13]

Sprague Dawley rats are most commonly used in the monoiodoacetate induced animal model in osteoarthritis study. Research on OA and discomfort associated with it frequently uses the MIA intra-articular injection paradigm. When 2 mg of MIA was injected intra-articularly into the hip joint, it caused end-stage hip OA and raised the production of the inflammatory neuropeptide calcitonin gene-related peptide in the dorsal-root ganglia. After nerve injury, it triggered transcription factor-3, a specific indicator of cell damage. In this OA model, microglia expression in the spinal cord also rose. Through the descending pain modulatory system, the regular injection of serotonin and norepinephrine reuptake inhibitors reduced hip pain, suggesting that end-stage OA is linked to both neuropathic and inflammatory pain.^[30]

Mono-iodoacetate (MIA), a metabolic inhibitor, can be injected intra-articularly to chemically induce knee OA. This substance prevents articular

chondrocytes from producing glyceraldehyde-3-phosphate dehydrogenase, which disrupts glycolytic energy metabolism and synthesis processes and ultimately results in cell death. Early stages of cartilage degeneration in rat and rabbit knee MIA models resulted in cartilage lesions with loss of proteoglycan matrix and chondrocyte death. Similar to human OA, increasing cartilage degradation, joint disintegration with exposed subchondral bone, discomfort, and functional impairment were observed [13]. To the best of our knowledge, however, intra-articular MIA injection to the rat hip has not been documented, in part due to the technical difficulty of the procedure.^[31]

Vigna Radiata L.

Mung beans are distributed globally in tropical and subtropical regions, with the largest production in Asia, particularly India. The wild forms of mung bean are widespread in central and east Africa, Asia and Australia. Today, they are cultivated in many Asian countries and also in parts of North America, Africa and Europe. The protein content of mung bean seeds ranges from 20.97 to 31.32%, making them especially high in protein. Revealed a 76% chemical score for mung bean amino acids, which was determined using the World Health Organization's and Food and Agriculture Organization's requirements. Therefore, it has been suggested that eating mung bean seeds along with cereals will greatly improve the quality of protein intake as part of a vegetarian diet because of its high protein content and digestibility. Mung bean protein isolates had an overall protein content of 87.8% and a total amino acid content of 800.2 mg/g.^[14]





Figure No. 2 Vigna Radiata L.

Table no. 1 Nutritional Composition of Vigna Radiata L.

1.	Protein	23.86g
2.	Carbohydrate	62.62g
3.	Calcium	132mg
4.	Vitamin B6	0.382mg
5.	Total dietary fiber	16.3g
6.	Total sugar	6.60g

Table no. 2 Taxonomical Classification of Vigna Radiata L.

1.	Botanical name	Vigna Radiata L.
2.	Common name	Moong, Mung bean
3.	Kingdom	Plantae
4.	Division	Magnoliophyta
5.	Class	Magnoliopsida
6.	Order	Fabales
7.	Family	Fabaceae
8.	Sub-family	Fabiodeae
9.	Genus	Vigna
10.	Species	Vigna Radiata

Like other legumes, mung beans are composed of 63% carbohydrates, 16% dietary fibre, 24% protein, and 1% fat. The majority of earlier research was primarily concerned with primary metabolites, like proteins and carbs. The purpose of this study was to investigate how the secondary metabolite content of mung beans varied depending on the sowing dates and growing regions. With a total fat level of 0.32-0.75g/100g, mung beans were low in fat. The fatty acid contents of mung bean lipids varied

considerably.^[15] With a range of 36.17-41.01g/100g total fatty acids, linoleic acid was the main fatty acid. Palmitic, α -linolenic, eicosanoic and oleic acids were also found. In contrast to the of 17-20g/100g total fatty acids, the oleic acid concentration varied between 4.06 and 6.79g/100g total fatty acid.^[16]

Pharmacological Activities: -

1. ANTI-ARTHRITIC ACTIVITY: -

A significant pulse crop found in the tropics and warm climates is *Vigna radiata* (Fabaceae). In this study, we assessed *Vigna radiata* sprouts' in vivo anti-arthritis and in vitro anti-inflammatory properties in rats. Protein denaturation and membrane stabilization were used to assess the in vitro anti-inflammatory efficacy. However, Diclofenac sodium was used as the standard medication in the full Freund's adjuvant model to assess the antiarthritic activity of the sprouts' ethanolic extract. Biochemical markers like lipid peroxidation, total reduced glutathione, myeloperoxidase, and lysosomal enzymes like cathepsin-D, N-acetyl β -D-glucosaminidase, and β -D-glucuronidase were estimated, along with body weights and paw volume. Significant membrane stabilizing and protein denaturation activity were demonstrated by treatment with *V. radiata* ethanolic extract, which also markedly reduced the biochemical alterations brought on by the administration of complete Freund's adjuvant. The results of this investigation point to *Vigna radiata*'s potential involvement in the treatment of arthritis.^[17]

2. ANTI-INFLAMMATORY ACTIVITY: -

Nitric oxide and pro-inflammatory cytokines, which are produced when the immune system is triggered, are associated with inflammation and can be brought on by a number of things, such as tissue damage, foreign body stimulation, and infection.^[18] Mung beans have been shown to be

beneficial in treating a range of inflammatory reactions, as evidenced by its use in traditional medicine and food, particularly in Asian countries. Clinical evidence of anti-inflammatory efficacy was obtained by analyzing the effect of ethanolic mung bean extract on lipopolysaccharide-stimulated macrophages. This activity was associated with the extract's polyphenols, vitexin, isovitexin, and gallic acid. Mung beans have been used in traditional medicine to treat heatstroke brought on by thirst, irritation, and the health advantages of the seeds and sprouts. Mung beans are beneficial for the inflammatory response.^[19]

3. ANTI-OXIDANT ACTIVITY: -

Antioxidant qualities have been shown in the seeds, shoots, and even shells of mung beans. Methanolic mung bean extract has high concentrations of free radicals and polyphenols. This strong antioxidant activity is caused by two main antioxidant molecules, vitexin and isovitexin.^[18] At a concentration of 100 micrograms/mL, the superior antioxidant potential of the methanolic extract of seed coverings has been shown using DPPH and FRPA methods. Additionally, because the seeds have more total flavonoids and phenolic compounds than raw seeds, they are utilized to extract acetone. The ability of mung bean seeds and soup to scavenge free radicals was compared with green tea and vitamin C2. Antioxidants help neutralize potentially harmful molecules called free radicals. When free radicals are present in large quantities, they can interact with biological components and cause harm.^[19]

4. ANTI-MICROBIAL ACTIVITY: -

Biocides, or phytochemicals having antibacterial interest, are gaining recognition because to their wide range of applications and lack of known adverse effects. The potential of mung beans as an antibacterial agent has been the subject of

numerous internet evaluations.^[18] Due to its high energy against fungus, such as *Fusarium oxysporum*, a nonspecific lipid transfer peptide has been found to have a wide range of antibacterial and antifungal interest. The bacteria adjacent to *Staphylococcus aureus* are *Sclerotium rolfsii*, *F. solani*, and *Pythium aphanidermatum*. The polyphenol extract from the sprouts shown antibacterial qualities against *Helicobacter pylori*, the pathogen that causes gastroduodenal disorders in humans.^[20] Several bean sprouts have potent antiviral and preventative qualities that protect against respiratory syncytial virus and herpes simplex virus-1; these qualities are similar to those of acyclovir. Further studies have shown that the proteins in beans have antiviral and antifungal qualities. These characteristics have been demonstrated to inhibit glycohydrolases and transcriptases linked to HIV infection.^[19]

5. ANTI-CANCER ACTIVITY: -

Through a number of underlying processes, mung bean proteins have been identified and are effective against the host tissues of most tumors. The unique anti-most cancer and immunomodulatory effects of methanolic extracts of mung bean sprouts have been evaluated in cervix adenocarcinoma and hepatocellular carcinoma mobile traces by looking at anti-most cancer cytokines, immunological cytokines, mobileular cycle regulatory genes, apoptotic gene expression, tumor suppressor genes, and the percentage of apoptotic cells.^[18] These results strongly imply that mung bean sprouts are a potent immunomodulatory and anti-cancer agent, creating new opportunities for cancer treatment. Additionally, research done in vitro has shown that mung beans have antiproliferative effects on a range of cancer cell lines, such as those from the breast, ovaries, and gastrointestinal system.^[19] Despite this, the correct procedures that alter the prevention of most cancers are widely known.



Mung beans have been shown in numerous studies to have anticancer effects through distinct mechanisms of action.^[20]

6. ANTI-DIABETIC ACTIVITY: -

Mung bean sprouts or seeds have been shown to be very beneficial for diabetics. When type 2 diabetic mice were given seeds and an ethanolic sprout extract orally, their blood glucose levels decreased and their levels of plasma C-peptide, triglycerides, total cholesterol, blood urea nitrogen, and glucagon were affected. Additionally, there has been a discernible improvement in insulin immunoreactive ranges and glucose tolerance multiplicity. Sprout ethanolic extracts were especially successful at controlling elevated blood sugar levels because of their high content of starch hydrolyzing enzyme inhibitors. High phenolic content material has been connected to this extract's ability to prevent intestinal absorption of carbohydrates, which decreases blood glucose levels.^[20] According to an analysis, the flavonoids and phenolic components of mung beans decreased the generation of reactive oxygen species and showed their ability to scavenge free radicals, hence controlling hyperglycemia. Similarly, those with diabetes were considered for additional mung bean starch containing 32% amylose.^[18] Additionally, the Chinese population reported that eating beans, veggies, and other meals high in legumes was associated with a lower incidence of type 2 diabetes. Based mostly on those findings, it has been concluded that delayed digestion, increased insulin sensitivity, and high fiber and amylose content lower the incidence of type 2 diabetes.^[19]

Finger Millet E.

Africa is where finger millet first appeared and was domesticated. This millet was already being grown by farming groups in eastern Africa around 5000 years ago, according to archaeological and

linguistic evidence. About 3000 years ago, the crop was brought from Africa to India, where it became the secondary centre of diversification on the subcontinent. Cytological, morphological and molecular data have all been used to support the ancestry of cultivated millet.^[21] similar to other cereals including rice, wheat, maize and millets, finger millet grain has an 81.5% carbohydrate content, 9.8% protein, 4.3% crude fibre and 2.7% mineral content. Compared to rice (0.2% fibre, 0.6% minerals) and wheat (1.2% fibre, 1.5% minerals), it has a surprisingly greater crude fibre and mineral content. Its protein profile is also quite well-balanced because it has higher levels of lysine, threonine and valine than other millets. Furthermore, black finger millet has 8.47g/g dry weight protein and 8.7mg/g dry weight fatty acid. Different types of finger millet have varying amounts of calcium (220-450) and iron (3-20%). Important amino acids that are lacking in other starchy foods, such as isoleucine (4.4g), leucine (9.5g), methionine (3.1g) and phenyl alanine (5.2g) are present in finger millet. Additionally, millets contain B vitamins, particularly niacin. Calcium, iron, potassium, magnesium, zinc, B6 and folic acid.^[22]



Figure No. 3 Finger Millet E.

Table no. 3 Nutritional Composition of Finger Millet E.

1.	Protein	7.6g
2.	Fat	1.5g
3.	Carbohydrates	88g
4.	Calcium	370mg
5.	Vitamin (A)	0.48mg
6.	Thiamine (B1)	0.33mg
7.	Riboflavin (B2)	0.11mg
8.	Niacin (B3)	1.2mg
9.	Fibre	3g

Table no. 4 Taxonomical Classification of Finger Millet E.

1.	Botanical name	Eleusine Coracana
2.	Common name	Ragi, Mandua
3.	Kingdom	Plantae
4.	Division	Angiosperms
5.	Class	Monocots
6.	Order	Poales
7.	Family	Poaceae
8.	Sub-family	Chloridoideae
9.	Genus	Eleusine
10.	Species	Eleusine Coracana

Their respective ranges were 7.08-9.41, 4.16-9.47, 2.91-5.32, 0.82-2.48, 1.32-2.95 and 73.57-78.47% for moisture, protein, fat, ash, crude fibre and carbohydrates. The flour's residual anti-nutrients for tannin, phytate, trypsin and oxalate were 1.20-2.23, 0.38-0.75mg/100g, 2.30-6.73% and 0.39-1.48mg /100g respectively. Phosphorus, sodium, calcium, potassium and iron ranged from 24.3-98.8, 0.123-0.90, 142.24-192.16, 105-396 and 2.20-6.59mg/100g respectively. The range of total phenolics was 16.00-40.29mg/100g. With longer soaking times and higher temperatures, the soaked finger millet flour's flavonoid and antioxidant activities rose.^[23]

Pharmacological Activities: -

1. ANTI-INFLAMMATORY ACTIVITY: -

The variety of finger millets and their anti-inflammatory properties. Inflammation is a

protective mechanism used by our immune system. The plant's anti-inflammatory qualities, oxidative burst inhibitory activity, and hyaluronidase enzyme inhibitory effects are all attributed to finger millet's many enzyme inhibitory activities, such as XO and A5-LOX enzyme inhibitory activities.^[24] The Oshadha methanolic extract exhibited the highest inhibitory action against XO (IC₅₀ value: 764.34 µg/ml) and A5-LOX (IC₅₀ value: 484.42 µg/ml) among all the extracts. All extracts showed less than 50% hyaluronidase inhibitory effectiveness at a dose of 1 mg/ml. With IC₅₀ values ranging from 26.9 to 27.7 µg/ml, methanolic extracts showed a modest degree of inhibitory power on reactive oxygen species (ROS) generated from whole blood phagocytes when compared to ibuprofen (IC₅₀ value: 11.18 µg/ml). All extracts demonstrated a significant decrease in ROS produced by polymorphonuclear neutrophils extracted from human blood as compared to ibuprofen (IC₅₀ value: 2.47 µg/ml). The ethanolic and methanolic extracts had IC₅₀ values between 0.29 and 0.47 µg/ml and 1.35 to 1.70 µg/ml, respectively. All of the extracts had remarkably high amounts of phenolic components, such as flavonoids and the capacity to scavenge oxygen radicals, 2,2-diphenyl-1-picryl-hydrazyl (DPPH), and 2,2'-azino-bis (3-ethylbenzothiazoline-6-sulfonic) acid (ABTS) cation.^[25]

2. ANTI-OXIDANT ACTIVITY: -

Antioxidants derived from plants, such as phenolics and flavonoids, have a variety of biological impacts. Antioxidants have a crucial role in reducing lipid peroxidation, a process associated with cancer and aging. Fatty acids and oils are protected from oxidative breakdown by antioxidants' persistent radical intermediates. Polyphenols found in the millet seed coat, including tannins, flavonoids, and phenolic acids, act as reducing agents by chelating metals,



quenching singlet oxygen, and quenching free radicals. Because the hydroxyl groups on phenol rings allow polyphenols to give hydrogen atoms to electron-deficient free radicals, they possess potent antioxidant qualities.^[26] Numerous studies have examined the antioxidant potential of phenolics and other bioactive compounds that were extracted from millet grains and their fractions. An ethanol extract of barnyard millet grains contained two flavonoids, one serotonin derivative, and three antioxidative phenolic compounds. Additionally, compared to 15% to 53% in other millet extracts, 1,1, diphenyl-2-picrylhydrazyl (DPPH) was inhibited by 70% in kodo millet flour methanol extracts. Additionally, the white varieties of finger millet, foxtail millet, and sorghum exhibited less quenching than their colored counterparts, indicating that the antioxidant activity may originate from phenolics in the seed coat. Additionally, compared to extracts from wheat, rice, and other millet species, finger millet extracts were found to have significantly higher radical-scavenging activity.^[27]

3. ANTI-DIABETIC ACTIVITY: -

The antidiabetic properties of finger millet are mostly associated with its high number of phenolic components and dietary fiber. The postprandial blood glucose level needs to be controlled for diabetes mellitus to be properly managed. This increase in blood glucose levels following meals can be mitigated with the use of dietary fiber. Additionally, finger millet's slower absorption and digestion of carbs help regulate blood glucose levels after meals. Finger millet may potentially have antidiabetic qualities because dietary calcium and magnesium have been demonstrated to reduce the risk of type II diabetes mellitus. A finger millet-based diet has been shown in separate studies on rat models to delay the onset of cataractogenesis and accelerate dermal wound healing. This suggests that finger millet can

prevent cataracts and impaired wounding, two conditions linked to diabetes, and that finger millet-based food products have lower glycemic indexes and lower glycemic responses.^[29]

4. ANTI-CANCER ACTIVITY: -

Dietary fiber is an important component of plant cell walls. Dietary fibers, also known as cell wall polysaccharides, are crucial parts of the human stomach that support gut health and facilitate digestion. Soluble dietary fiber (SDF) and crude fiber, also referred to as insoluble dietary fiber (IDF), are the two forms of dietary fiber derived from millet. While SDF is soluble in water and made up of pectins, glucans, and some hemicellulose, IDF is insoluble in water and contains cellulose, hemicellulose, and lignin. Compared to IDF, SDF is more nutrient-dense, absorbs more water, forms a gel-like structure, lowers cholesterol (fatty substances lodged in the GI tract), ferments the gut flora in the large intestine, regulates the immune system, and has anti-tumor properties.^[28]

5. ANTI-AGING ACTIVITY: -

Promising candidate chemical entities with antiaging potential can be derived from a variety of structural scaffolds present in natural compounds. Several published works of literature emphasize how eating millet may assist avoid aging and age-related issues. The exact mechanism of action is still unknown, though. However, these results suggest that phytochemicals produced from millets may be able to greatly decrease aging-related diseases, genetic repair, protein glycation, and stress-responsive pathways. The influence of millets on all these pathways can be linked to their antioxidant qualities and possible anti-aging effects, as several aging theories explain below.^[26]



CONCLUSION

Osteoarthritis is a complicated degenerative joint disease for which there are few effective treatments because existing therapies mostly alleviate symptoms without changing the course of the illness. Due to their abundance of bioactive chemicals with anti-inflammatory and antioxidant qualities, plant-based nutraceuticals like Eleusine coracana (finger millet) and Vigna radiata (mung bean) exhibit great potential. Key pathogenic pathways associated with OA may be modulated by these natural substances. Their therapeutic value is supported by data from animal models, especially the monoiodoacetate-induced model in Sprague Dawley rats. All things considered, using them provides a secure, economical, and successful substitute method for treating osteoarthritis.

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